

What is claimed is:

- 1 1. A flat panel x-ray tube assembly comprising:
2 a cathode assembly including a plurality of emitter elements;
3 an anode substrate having a substrate upper surface facing said
4 plurality of emitter elements and a substrate lower surface, said substrate upper
5 surface positioned parallel to said plurality of emitter elements;
6 a plurality of target wells formed in said substrate upper surface,
7 each of said plurality of target wells comprising an first angled side surface
8 positioned in an acute angle relative to said substrate upper surface; and
9 a plurality of first target elements applied one to each of said first
10 angled side surfaces, said first target elements generating x-rays in a direction
11 perpendicular to said plurality of emitter elements in response to electrons
12 received from one of said plurality of emitter elements.
- 1 2. A flat panel x-ray tube assembly as in claim 1 further
2 comprising:
3 a second angled side surface formed in each of said plurality of
4 target wells, each of said second angled side surfaces opposing one of said first
5 angled side surfaces, each of said second angled side surfaces positioned in an
6 acute angle relative to said substrate upper surface; and
7 a plurality of second target elements applied to each said second
8 side surfaces, said plurality of second target elements generating x-rays in a
9 direction perpendicular to said plurality of emitter elements in response to
10 electrons received from one of said plurality of emitter elements.
- 1 3. A flat panel x-ray tube assembly as in claim 1 wherein
2 said first target element comprises a thin film.
- 1 4. A flat panel x-ray tube assembly as in claim 1 wherein
2 said first target element comprises tungsten or other suitable material for
3 generating hard x-rays by electron impact in a transmission mode.

1 5. A flat panel x-ray tube assembly as in claim 1 wherein
2 said first angled surface connects a target well base to said substrate upper
3 surface.

1 6. A flat panel x-ray tube assembly as in claim 1 wherein
2 said first target element is in thermal communication with said first angled
3 surface such that thermal energy accruing during the generation of x-rays is
4 dissipated into said anode substrate.

1 7. A flat panel x-ray tube assembly as in claim 1 wherein
2 said plurality of target wells comprise a line of target wells.

1 8. A flat panel x-ray tube assembly as in claim 1 wherein
2 said plurality of target wells comprise a two-dimensional matrix of target wells.
3

1 9. A flat panel x-ray tube assembly comprising:
2 a cathode assembly including a plurality of emitter elements, said
3 plurality of emitter elements generating a plurality of electron beams;
4 a substrate including a plurality of first angled side surfaces, each
5 of said first angled side surfaces in communication with one of said plurality of
6 electron beams, each of said first angled side surfaces angled relative to said
7 plurality of electron beams such that one of said plurality of electron beams
8 approaches one of said first angled side surfaces at an acute angle; and
9 a plurality of first target elements applied to each of said
10 plurality of first angled side surfaces, each of said plurality of first target
11 elements positioned parallel with one of said plurality of first angled surfaces,
12 each of said plurality of first target elements generating x-rays in a direction
13 parallel to one of said plurality of electron beams.

1 10. A flat panel x-ray tube assembly as in claim 9 further
2 comprising:

3 a plurality of second angled side surfaces formed in said
4 substrate, each of said second angled side surfaces facing one of said first
5 angled side surfaces, each of said second angled side surfaces angled relative to
6 said plurality of electron beams such that one of said plurality of electron beams
7 approaches one of said second angled side surfaces at an acute angle; and
8 a plurality of second target elements applied to each of said
9 plurality of second angled side surfaces, each of said plurality of second target
10 elements positioned parallel with one of said plurality of second angled
11 surfaces, each of said plurality of second target elements generating x-rays in a
12 direction parallel to one of said plurality of electron beams.

1
1 11. A flat panel x-ray tube assembly as in claim 9 wherein
2 one of said plurality of electron beams approaches one of said first angled side
3 surfaces at an angle less than 45 degrees.

1 12. A flat panel x-ray tube assembly as in claim 9 wherein
2 said substrate comprises a graphite anode substrate.

1 13. A flat panel x-ray tube assembly as in claim 9 wherein
2 each of said plurality of first target elements is in thermal communication with
3 said substrate such that thermal energy accruing during the generation of x-rays
4 is dissipated into said substrate.

1 14. A flat panel x-ray tube assembly as in claim 9 wherein
2 said first target element comprises a thin film of tungsten or other suitable high
3 Z materials.

1 15. A flat panel x-ray tube assembly as in claim 9 wherein
2 said plurality of first target elements comprise a line of target elements.

1 16. A flat panel x-ray tube assembly as in claim 1 wherein
2 said plurality of first target elements comprise a two-dimensional matrix of
3 target elements.

1 17. A method of generating a plurality of x-ray beams having
2 a plurality of focal spots comprising:
3 generating a plurality of electron beams from a plurality of
4 emitter elements;
5 impacting one of said electron beams into one of a plurality of
6 first target elements, each of said first target elements mounted on a first angled
7 side surface of a substrate;
8 striking said first target element with said electron beam at an
9 acute angle;
10 releasing x-rays from each of said first target elements in a
11 direction parallel to one of said plurality of electron beams; and
12 dissipating thermal energy from each of said plurality of first
13 target elements into said substrate.

1 18. A method of generating a plurality of x-ray beams having
2 a plurality of focal spots as described in claim 17, further comprising:
3 impacting one of said electron beams into one of a plurality of
4 second target elements, each of said second target elements mounted on a
5 second angled side surface of said substrate, said second angled side surfaces
6 facing said first angled side surfaces; and
7 striking said second target element with said electron beam at an
8 acute angle; and
9 releasing x-rays from each of said second target elements in a
10 direction parallel to one of said plurality of electron beams.

1 19. A method of generating a plurality of x-ray beams having
2 a plurality of focal spots as described in claim 17, further comprising:
3 generating a plurality of x-ray focal spots along a linear line.

1 20. A method of generating a plurality of x-ray beams having
2 a plurality of focal spots as described in claim 17, further comprising:

3 generating a plurality of x-ray focal spots along a two
4 dimensional matrix.